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## RAISED BOGS IN EASTERN MAINE

By **GEORGE E. NICHOLS**  
Yale University

### OCCURRENCE OF SURGICAL SPHAGNUM

During the summer of 1918 the writer, acting in the capacity of Botanical Adviser on Sphagnum for the American Red Cross, was called upon to secure information regarding the location in the East of sources of supply for sphagnum moss suitable for use in surgical dressings. Sphagnum was being used on a vast scale abroad and in Canada as a substitute for absorbent cotton in making pads or compresses and had proved itself singularly adapted to this purpose by reason of its very high absorptive capacity.<sup>1</sup> In March, 1918, it had been officially adopted by the American Red Cross as a standard surgical material. But, while there were known to be extensive areas of suitable moss in the Pacific Northwest, very few data were available regarding its occurrence in the East. There had been, and there continued to be, reports of good material from various sections; but investigation of these, as well as other sources of information, had seemed to indicate that throughout most of the eastern United States sphagnum of the quality required for surgical work, if not entirely absent, was either very local in its occurrence or else present in too small amounts to be of practical value. It was known, however, that in southern New Brunswick and in parts of Cape Breton, there were abundant supplies of high-grade surgical sphagnum.

### ITS ASSOCIATION WITH RAISED BOGS

It was also known that in these regions raised bogs were of frequent or even common occurrence. The theory therefore suggested itself that the raised bog might well be taken as an indicator of climatic conditions suitable to the growth of surgical sphagnum. In other words, since a raised bog is itself largely built up by various species of sphagnum and since it is dependent for its existence on precisely those climatic conditions which are congenial to the development of surgical sphagnum, it naturally follows that surgical sphagnum is to be looked for in greatest abundance and luxuriance in regions where raised bogs are well developed. With this deduction in mind, it was decided that the region in the eastern United States where the chances of success in locating supplies of surgical moss were the most favorable lay along the coast of eastern Maine. For, while there was very little favorable evidence in the way of either reports or

<sup>1</sup> For a somewhat detailed discussion of this subject see the writer's article: The Sphagnum Moss and Its Use in Surgical Dressings, *Journ. New York Botanical Garden*, Vol. 19, 1918, pp. 203-220; also reprinted in *Scientific American Suppl.* No. 2237, Vol. 86, 1918, Nov. 16, pp. 308-311, under the title "Are You Collecting Sphagnum?"



FIG. 1.—General view of the Denbo Heath, a large raised bog at Deblois, Maine, covering several square miles of territory. The bushy foreground and the tract of partly burned forest in left mid-distance are not in the bog itself.

herbarium specimens, it was known that eastern Maine was a very boggy country and also, in a vague way, that some at least of the bogs were of the raised type.

#### THE FIELD INVESTIGATED

Altogether, one month was spent in this region. Starting in at Portland and at Wayne (situated approximately 50 miles north of Portland) investigations were conducted in the vicinity of fourteen different towns between there and Calais, which lies on the Canadian border. In nearly all of these localities an automobile was placed at the writer's disposal during his stay, so that it was possible to cover a great deal of territory within the limited time available. In addition, in many places a competent guide was provided, which facilitated matters greatly. Under the circumstances it was of course impossible to make any detailed studies along strictly botanical lines, and very few written data were secured; but it was equally impossible to neglect entirely the ecological aspects of the trip, particularly certain very obvious facts regarding the occurrence and general features of the raised bogs in this region. It is these which form the principal theme of the present paper.

#### STATE OF KNOWLEDGE REGARDING NORTH AMERICAN RAISED BOGS

The raised bog or high moor is one of the most remarkable of all swamp types. It is a type of swamp extensively developed in parts of northern Europe and has been described in great detail by various European scientists. But comparatively little has been written regarding these swamps in North America. Shaler, in his monograph on the freshwater morasses of the United States, seems to have been the first to call attention to their occurrence on this continent. His observations were as follows:

In northern Europe and elsewhere the species of sphagnum often develop luxuriantly on slopes having a declivity of as much as  $5^{\circ}$ , so that the bog may rise to the height of some scores of feet above the level of the water in which it originates and may ultimately come to have many times its original horizontal extent. Within the limits of the United States the summers are generally so hot and dry that the climbing bogs due to sphagnum growth are of inconsiderable extent and rarely have an inclination of more than  $2^{\circ}$ . The American instances of these climbing bogs which I have observed are mostly limited to the eastern portion of Maine, near the shores of the Bay of Fundy. Faint traces of the same mode of growth are observable in certain areas of New Hampshire, and in a yet slighter measure in the northern part of Michigan and Minnesota. Even as far south as the swamps of Virginia and Carolina the sphagnum grows weakly above the level of permanent water, but it does not form a sufficiently thick mat to induce a permanent marshy character on the surface. I have never seen the coating of humus produced by it with a thickness of more than six inches in that part of the country.<sup>2</sup>

Ganong was the first to publish an adequate description of this unique type of swamp in North America. He discussed in considerable detail the raised bogs in that part of the Province of New Brunswick bordering the

<sup>2</sup> N. S. Shaler: General Account of the Fresh-Water Morasses of the United States, with a Description of the Dismal Swamp District of Virginia and North Carolina, 10th Ann. Rept. U. S. Geol. Survey, 1888-89, Part I, pp. 255-389; reference on p. 286.

Bay of Fundy and indicated the occurrence of similar tracts in Nova Scotia, Anticosti, and Newfoundland.<sup>3</sup> In a later paper he described the raised bogs found on Miscou Island, in northern New Brunswick.<sup>4</sup> More recently Anrep has given a brief account of certain raised bogs on the peninsula of Nova Scotia and has indicated the absence of bogs of this type from those parts of Manitoba, Ontario, and Quebec which he had explored.<sup>5</sup>

The writer of the present article has described at some length the raised bogs of northern Cape Breton<sup>6</sup> and has noted the marked resemblance which these bear to those described by Ganong in New Brunswick. It was remarked that in all probability the raised bog is a not infrequent type of swamp along the Maine coast as far south as the vicinity of Portland, and that it evidently is of quite common occurrence northeastward. This conclusion was based very largely on scattered observations made by Bastin and Davis in their report on the peat deposits of Maine, Shaler's remarks having unfortunately been overlooked. Bastin and Davis distinguished between two types of peat deposit: "the filled basin, in which most of the material has been gathered below a permanent water level, and the built-up plain, in which the water level may be practically always below the surface of the peat, but in which it rises, either steadily or periodically, as the remains of plants collect."<sup>7</sup> Bogs of the latter type the authors also designated as "built-up bogs" but, whether intentionally or not, they did not employ the terms "raised bog" or "high moor."

But although in a general way it is to be inferred from the Bastin and Davis report that many Maine bogs belong to the built-up type, in only a very few instances out of the seventy swamp tracts treated do they clearly indicate whether the surface in specific bogs is flat or convex, or whether these belong to the filled-in or to the built-up type. Yet it would seem to the writer that the contour of the surface of a deposit ought naturally to be one of the first things noted by a peat investigator; since surely a dome-shaped bog, especially one overlying a nearly flat land surface, must be far more easy to work than a flat bog formed in a water-filled depression.

#### COASTAL REGION OF MAINE THE CHIEF AREA OF DEVELOPMENT IN THE EASTERN UNITED STATES

During the summer of 1917, in company with Dr. Harold St. John of the Gray Herbarium, the writer traveled by canoe from Moosehead Lake,

<sup>3</sup> W. F. Ganong: On Raised Peat-Bogs in New Brunswick, *Botanical Gazette*, Vol. 16, 1891, pp. 123-126.

*Item:* Upon Raised Peat-Bogs in the Province of New Brunswick, *Trans. Royal Soc. of Canada*, 2d Ser., Vol. 3, Section IV, 1897, pp. 131-163.

<sup>4</sup> *Item:* On the Physical Geography of Miscou, *Bull. Nat. Hist. Soc. of New Brunswick* No. 24, St. John, N. B., 1906, pp. 447-462.

<sup>5</sup> A. Anrep: Investigation of the Peat Bogs and the Peat Industry in Canada, 1913-14, *Canada Dept. of Mines Branch Publ.* 351, Ottawa, 1915.

<sup>6</sup> G. E. Nichols: The Vegetation of Northern Cape Breton Island, Nova Scotia, *Trans. Conn. Acad. Arts and Sci.*, Vol. 22, 1918, pp. 249-467; see especially pp. 433-456.

<sup>7</sup> E. S. Bastin and C. A. Davis: Peat Deposits of Maine, *U. S. Geol. Surv. Bull.* 376, Washington, D. C., 1909.

in northwestern Maine, northward up the northeast branch of the Penobscot River, across by carry into the headwaters of the St. John River, and thence down the St. John to Fort Kent, a distance altogether of about two hundred miles. Nowhere along this route was anything in the nature of a raised bog encountered. In view of these and other observations it seems safe to assert: (1) that in the state of Maine raised bogs, in so far as they constitute a distinctive swamp type, are virtually restricted to the proximity of the seacoast; and (2) that in other portions of New England and



FIG. 2—A characteristic view of the vegetation in the Denbo Heath, a raised bog at Deblois, Maine. A dense growth of low shrubs, mainly members of the heath family, covers the surface over much of the bog.

of the eastern United States this type of bog is practically absent, although in occasional swamps it is possible to detect a slight elevation of the surface above the level of permanent ground water.

#### DESCRIPTION OF RAISED BOGS ALONG THE MAINE COAST

An itinerary of the route covered by the writer in eastern Maine during the summer of 1918 is given below, together with brief observations regarding the occurrence, etc., of raised bogs in this region.

*Portland.* No raised bogs were seen or reported in this vicinity, although several flat bogs were visited. Bogs of any description, however, are comparatively infrequent.

*Wayne.* This region abounds in bogs of the flat type.<sup>8</sup> Of the fifteen bogs visited, only one (Burr, Area 8) is distinctively of the raised type,

<sup>8</sup> See F. F. Burr: The Occurrence of Peat in the Livermore Quadrangle, Maine, *2d Ann. Rept. Public Utilities Commission, State of Maine, for the Year Ending Oct. 31, 1916*, Waterville, 1917, pp. 76-97.

and even in this case the elevation of the center above the margin is slight, scarcely two or three feet.

*Augusta.* The Great Sydney Bog, situated about five miles north of this city (Bastin and Davis, Locality 25), is a typical raised bog. It covers an area of about one square mile and exhibits the convex surface contour so characteristic of raised bogs. Between the lower parts along the margin and the higher parts toward the center there is a vertical difference in elevation of more than six feet (measured with hand level). The northeast portions of the bog are lower than the southwest, but it apparently is drained by brooks at either end. Eighty miles of travel in the vicinity of Augusta failed to reveal any other raised bogs.

*Waldoboro.* About fifteen bogs were visited in this swampy district. Several of these appeared to be of the "built-up" type (having been formed over flat ground rather than in a depression), but in only one instance was the domed surface contour evident. In this case, a small bog bordering Sidensparker Pond, there is a rise of two or three feet from margin to center.

*Rockland.* A large bog situated about two miles west of this city (Bastin and Davis, Locality 29) and covering an area of somewhat over a square mile obviously belongs to the built-up type. It is perhaps four feet higher toward the center than around the lower parts of the margin. Bogs of any description are infrequent in this vicinity.

*Belfast.* The region about Quantabacook Pond, a dozen miles west of Belfast, abounds in bogs, many of them large. Some of them are slightly raised, but most of them are of the flat type.

*Bangor.* The Hermon Bog (Bastin and Davis, Locality 38), situated four miles west of Bangor, is a very fair example of a raised bog, definitely convex in surface contour and rising perhaps five feet from margin to center. It is about a square mile in area. The Chemo Pond bog, in the town of Bradley, about ten miles east of Bangor, was not seen but is judged from reports to be a large raised bog.

*Old Town.* Bordering Pushaw Lake, and mostly in the town of Old Town, is an immense bog many square miles in area (Bastin and Davis, Locality 41). In large part the bog surface appears flat, but in many places, as south of Mud Pond, it has been built up well above the level of the lake. Northwest of Old Town, bordering Birch Stream, in the town of Alton, for several miles, is an immense bog of the built-up type (Bastin and Davis, Locality 34); but the surface, so far as observed, is only slightly elevated above that of the clay flat which it overlies. The bog bordering Holland Pond in Alton (Bastin and Davis, Locality 33) rises several feet above the level of the pond. None of the bogs visited from either Bangor or Old Town compare with those seen farther east in the height to which the surface has been elevated.

*Ellsworth and Franklin.* Of the dozen bogs visited in this vicinity,

Garland's Heath, situated along the western edge of Union River about six miles north of Ellsworth, is a fine specimen of raised bog. It occupies an area of about a square mile and exhibits a conspicuously convex surface contour, rising more than ten feet vertically from margin to center. The presence of several other raised bogs in this vicinity is suggested from a study of the map. A number of these areas are specifically designated as "heath" (locally pronounced "haythe" or "hake"), a term which throughout eastern Maine is employed primarily (though unconsciously) with reference to raised bogs. For reasons which will be given later no attempt was made to visit these bogs.

*Cherryfield and Columbia Falls.* Four very characteristic raised bogs were visited in this section and a number of others were seen from a distance. One of those visited is a small bog, perhaps forty acres in extent, lying about three miles northeast of Cherryfield (Bastin and Davis, Locality 48). Its domed surface rises perhaps six feet from margin to center. A much larger raised bog is situated in the town of Deblois, about fifteen miles north-northwest of Cherryfield (Figs. 1, 2). Locally this is known as the Denbo Heath. Its area is unknown, but it must cover several square miles. In height it surpasses any of the bogs yet mentioned, its domed center rising fully eighteen feet (measured with hand level) higher than the margin. The Great Columbia Bog (Bastin and Davis, Locality 49) is probably still larger, covering altogether an area estimated at about five square miles along the Pleasant River. Its southern margin lies about six miles northwest of Columbia Falls, but it was also visited from the Cherryfield side—a somewhat longer journey. Regarding this area Bastin and Davis write: "Only the western portion of the bog . . . was tested, but test holes . . . failed to show more than three feet of mucky peat. It is possible, though hardly likely, that in other parts of the bog the depth of the peat may be greater." Yet less than two miles east of the area just referred to there is an immense raised bog which rises, if anything, to an even higher elevation than the Denbo Heath. The surface in places must be underlain by fully twenty feet of peat. No accurate measurements were taken. The fourth raised bog visited in this vicinity is situated a few miles northeast of the village of Columbia Falls. It is about one square mile in area and rises ten or more feet toward the center.

*Machias.* Several raised bogs were noted in this vicinity, but only one, a small one, was visited. For reasons which will be obvious presently attention was focused primarily on the flat bogs bordering lakes and ponds. The region east of Machias, between there and Lubec, was not explored, but a study of the map and of the Bastin and Davis report leaves little doubt that the raised bog is a common type in this section.

*Calais.* Along the western shore of Meddybemps Lake, ten miles southwest of Calais, there are several good-sized and very characteristic raised bogs. Similar bogs doubtless occur along many of the other lakes, in which this wild section of the country abounds.

## GENERAL DISTRIBUTION OF RAISED BOGS ALONG THE MAINE COAST

The observations set forth in the preceding paragraphs may be summarized as follows. (1) Raised bogs occur in greater or less abundance along much of the Maine coast east of Casco Bay. (2) They are most frequent and reach their best development east of Penobscot Bay. (3) In Washington County they are a common bog type and attain large proportions, frequently covering considerable tracts of country. (4) West of Penobscot Bay raised bogs are infrequent and, on the whole, poorly developed, although there is at least one conspicuous exception—the Great Sydney Bog. (5) How far away from the coast raised bogs, as a distinctive swamp type, occur has not been determined, but the Great Sydney Bog lies fully thirty miles inland.

It seems unnecessary here to say anything regarding the origin, vegetation, and other features of raised bogs in Maine. So far as observed, they seem to agree in practically every respect with the raised bogs of New Brunswick and northern Cape Breton, which have been amply described by Ganong<sup>9</sup> and the writer.<sup>10</sup>

## GEOGRAPHICAL AND LOCAL DISTRIBUTION OF SURGICAL SPHAGNUM

A few further remarks regarding the distribution of species and qualities of sphagnum suitable for surgical use may be of relevant interest. In so far as their geographical distribution is concerned, the assumed indicator significance of the raised bog, elsewhere suggested, seems to hold true. *Sphagnum papillosum*, the species best adapted to surgical requirements, is most widely distributed and most luxuriantly developed eastward; but it is further important to note that in its local distribution surgical sphagnum is by no means confined to the raised bogs. Quite the contrary. Good material is frequently found, indeed in considerable quantities, on the raised bogs, but here it is largely restricted to the margins of small ponds and to wet depressions and is scarce on the drier areas which comprise the greater part of the bog surface. The vast bulk of the sphagnum which grows on such a bog is worthless from a surgical point of view. Much of the best surgical moss and by far the largest quantities (this is particularly true of *Sphagnum papillosum*) are to be found in the wet, flat, "floating" bogs that border lakes and ponds; and these, nearly everywhere in eastern Maine, are of frequent occurrence. It was because of this discovery that more effort was not made to locate and explore the raised bogs. Unfortunately, from the surgical standpoint, the lumberman has brought about the destruction of many of the best areas of surgical sphagnum in eastern Maine. In their natural condition the "flowage" swamps, which border so many of the lakes and streams in this region, afford ideal conditions for the development of such moss. But *Sphagnum papillosum* in particular is extremely sensitive to any change in environment, and it has been

<sup>9</sup> *Op. cit.*

<sup>10</sup> Work cited in footnote 6.

drowned out over vast areas, in which, without question, it formerly abounded, by the damming of the streams and regulation of the water-flow. Similarly, in the great blueberry district about Cherryfield and Columbia Falls the repeated burning-over of the country in the interest of the blueberry crop has had a disastrous effect on the sphagnum.

#### DISTINCTION BETWEEN "MOSS BOG" AND "HEATH" BY BASTIN AND DAVIS

In conclusion, the writer cannot refrain from one other criticism of the Bastin and Davis peat report. In describing the various bogs and swamps the authors attempt to depict the character of the surface vegetation. Of particular significance in the writer's search for supplies of surgical sphagnum appeared to be the seemingly sharp distinction which they made between "moss bog" and "heath." Such a distinction, if accurately drawn, would have proved of the utmost assistance; for while a true moss bog is quite apt to contain surgical moss in quantity, a heath is equally apt to contain none at all. Experience soon showed that the distinction implied by Bastin and Davis in reality signified nothing, the "moss bogs" in all cases examined proving to be in no wise different from what elsewhere was more correctly described as heath. It may be suggested that, in general, a somewhat more accurate characterization of the botanical aspects of bogs on the part of peat investigators would add considerably to the scientific value of their work.